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WHAT IS CLAIMED IS:

1. (Amended) A method for fabricating a silicon carbide semiconductor device, the method comprising the steps of:

(a) implanting impurity ions into a silicon carbide layer;

(b) heating the silicon carbide layer under a pressure condition lower than an atmospheric pressure to form a carbon layer on a surface of the silicon carbide layer; and

(c) after the step (b), performing an activation annealing process with respect to the silicon carbide layer in an atmosphere at a temperature higher than in the step (b) and under a pressure condition higher than in the step (b).

2. (Canceled)

3. The method of claim 1, wherein the steps (b) and (c) are performed in the same heating furnace.

4. The method of claim 1, wherein the step (b) includes forming the carbon layer in the presence of a gas containing hydrogen.

5. The method of claim 1, wherein the step (b) includes forming the carbon layer under a pressure condition not lower than 1x 10^{-5} Pa and not higher than 10 Pa.

6. The method of claim 1, wherein a temperature of the silicon carbide layer is not lower than 1100 °C and not higher than 1400 °C in the step (b).

7. The method of claim 1, wherein the step (c) includes performing the activation annealing process by adjusting a temperature of the silicon carbide layer to a range not lower than 1500 °C and not higher than 2000 °C under a pressure condition not lower than 1 kPa and not higher than 100 kPa.

8. The method of claim 1, further comprising the step of:

(d) after the step (c), heating the silicon carbide layer in the presence of a gas containing oxygen atoms to remove the carbon layer.

9. The method of claim 8, wherein a temperature of the silicon carbide layer is not lower than 550 °C and not higher than 1000 °C in the step (d).

10. The method of claim 8, wherein the removal of the carbon layer in the step (d) is performed in the same heating furnace as the activation annealing process in the step (c).

11. A silicon carbide semiconductor device comprising: a silicon carbide layer; an impurity doped layer formed in a part of the silicon carbide layer; and an electrode provided on the silicon carbide layer, wherein a step height at an upper surface of the silicon carbide layer is substantially the same in the impurity doped layer and in a region of the silicon carbide layer other than the impurity doped layer.

12. The silicon carbide semiconductor device of claim 11, wherein the step height at the upper surface of the silicon carbide layer is not less than 0.1 nm and not more than 1 nm.

13. The silicon carbide semiconductor device of claim 11, wherein a concentration of an element in the impurity doped layer other than carbon, silicon, and a dopant of the impurity doped layer is not higher than 1×10^{14} cm^{-3}.

14. The silicon carbide semiconductor device of claim 13, wherein the element is hydrogen, oxygen, chromium, nickel, manganese, or iron.

15. The silicon carbide semiconductor device of claim 11, further comprising:

a gate insulating film provided on the silicon carbide layer;

a gate electrode provided on the gate insulating film; and

a first electrode in ohmic contact with the silicon carbide layer.

16. The silicon carbide semiconductor device of claim 15, further comprising:

a silicon carbide substrate provided on a lower surface of the silicon carbide layer; and

a second electrode in ohmic contact with a lower surface of the silicon carbide substrate.

17. The silicon carbide semiconductor device of claim 11, further comprising: a third electrode in Schottky contact with the silicon carbide layer.

Unofficial Comments on the Written Opinion of the International Searching Authority

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In the present Amendment Under PCT Article 19, the applicant amend the independent claim 1 to include the limitations of claim 2.

The invention recited in the present claim 1 is a method for manufacturing a silicon carbide semiconductor device having a silicon carbide layer into which impurity ions are implanted. The present invention is characterized in that after the silicon carbide layer is heated under a reduced pressure below atmospheric pressure to form a carbon layer on the surface of the silicon carbide layer, the silicon carbide layer is subjected to anneal treatment for activation in a higher temperature atmosphere as well as under higher pressure than in the step of forming the carbon layer. By this characteristic, the present invention gains significant effect that the high activation rate of impurities is achieved while keeping the flatness of the surface of the silicon carbide semiconductor layer.

On the other hand, the cited reference JP2002-184714A discloses the step-like surface roughness of the substrate that is caused by heating the silicone carbide at or above 1420℃ at which migration starts to occur on the substrate. The reference is different from the present invention in that it fails to disclose anything about a silicon carbide layer receiving heat treatment under a reduced pressure. For the foregoing reason, the present invention cannot be easily anticipated by the invention in the cited reference.